Technical Report
South Lake Union Streetcar Project

Air Quality

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Chapter 1 Abstract/Summary

This technical report analyzes existing air quality conditions and potential impacts associated with the South Lake Union Streetcar Project. This project would meet all regional and local conformity requirements.

1.1 Studies, Coordination, and Methods

Localized carbon monoxide (CO) concentrations were modeled for existing conditions (2002), opening year (2007) and design year (2030), using standardized Puget Sound Regional Council (PSRC) and Environmental Protection Agency (EPA) modeling procedures.

1.2 Affected Environment

CO concentrations were modeled at five intersections in the project area.

The predicted worst-case CO concentrations for existing conditions (2002) would not exceed the one-hour average or the eight-hour average National Ambient Air Quality Standards (NAAQS) for CO at any location. Predicted maximum eight-hour CO concentrations from vehicle emissions under existing conditions ranged between 4.8 ppm and 8.5 ppm. This is below the eight-hour average NAAQS of 9 ppm for CO.

1.3 Impacts

Predicted worst-case one-hour and eight-hour average CO concentrations were evaluated for the streetcar project, and found to be within air quality standards, therefore no impact is predicted. The operational impacts of other pollutants would be less than for CO. The streetcar project was also included in regional conformity modeling completed by the Puget Sound Regional Council. Regional pollutant emissions, including the effects of the streetcar project, were demonstrated to be within regionally allowable amounts.

If the streetcar is built, the predicted worst-case CO concentrations for years 2007 and 2030 would not exceed the one-hour average or the eight-hour average NAAQS for CO at any location (Table 1-1). Predicted maximum eight-hour CO concentrations from vehicle emissions under the build alternative ranged between 4.0 ppm and 7.6 ppm for the opening year (2007) and 3.0 ppm and 5.3 ppm for the design year (2030). These values are all below the eight-hour average NAAQS of 9 ppm for CO.

If the streetcar project is not built, predicted maximum eight-hour CO concentrations from vehicle emissions (Table 1-1) would range between 4.0 ppm and 7.6 ppm for the opening year (2007) and 3.0 ppm and 5.3 ppm for the design year (2030). These values are all below the eight-hour average NAAQS of 9 ppm for CO.

Because the project would not cause or contribute to any violation of the NAAQS for CO, it would not cause any adverse localized CO impacts.

Table 1-1: Summary of Air Quality Impacts and Mitigation

Alternative	Construction Impacts	Operation Impacts	Mitigation Measures
Baseline (Without the Streetcar Built)	None	Worst-case eight-hour CO concentrations were modeled to range between 4.0 ppm and 7.6 ppm in 2007 and 3.0 ppm in 5.3 ppm in 2030.	None required
Build (With the Streetcar Built)	Construction activities would result in temporary emissions of pollutants	Worst-case eight-hour CO concentrations were modeled to range between 4.0 ppm and 7.6 ppm in 2007 and 3.0 ppm in 5.3 ppm in 2030.	Use of Best Management Practices during construction would control particulate emissions. No mitigation would be required during operation.

1.4 Mitigation

Because no exceedance of NAAQS is predicted, no design or operational changes would be required.

Construction impacts could include particulate matter (PM), oxides of nitrogen (NO_x) and carbon monoxide (CO). Construction activities would result in temporary pollutant emissions, including dust and odors. To reduce dust emissions, Best Management Practices (BMP) would be required during construction to meet City of Seattle Standard Specification 1-07.5(3).

Chapter 2 Introduction

This report describes the potential air quality impacts associated with construction and operation of South Lake Union Streetcar Project. It provides background project information, discusses transportation air quality in general, assesses the potential for air quality impacts, and discusses appropriate impact avoidance measures.

2.1 Background

Air quality in the project area is regulated by the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Department of Ecology), and the Puget Sound Clean Air Agency (PSCAA). Under the Clean Air Act, EPA has established the National Ambient Air Quality Standards (NAAQS), which specify maximum concentrations for carbon monoxide (CO), particulate matter less than 10 micrometers in size (PM_{10}), particulate matter less than 2.5 micrometers in size ($PM_{2.5}$), ozone, sulfur dioxide, lead, and nitrogen dioxide. The standards applicable to transportation projects are summarized in Table 2-1. The eight-hour ozone and $PM_{2.5}$ standards are in the process of being implemented by the EPA. The eight-hour CO standard of 9 parts per million (ppm) is the standard most likely to be exceeded as the result of transportation projects. Nonconformance with NAAQS can threaten federal funding of transportation projects.

Nonattainment areas are geographical regions where air pollutant concentrations exceed the NAAQS for a pollutant. Air quality maintenance areas are regions that have recently attained compliance with the NAAQS. The South Lake Union Streetcar Project area lies within ozone and CO maintenance areas (Figure 2-1). Air quality emissions in the Puget Sound Region are currently being managed under the provisions of Air Quality Maintenance Plans (AQMP) for ozone and CO. The current plans were developed by PSCAA and the Department of Ecology and approved by the EPA in 1996. Any regionally significant transportation project in the Puget Sound Air Quality Maintenance Area must conform to the AQMPs. Conformity is demonstrated by showing that the project would not cause or contribute to any new violation of any NAAQS, would not increase the frequency or severity of any existing violation of any NAAQS, or would not delay timely attainment of the NAAQS.

Table 2-1: Summary of Ambient Air Quality Standards

Pollutant	National Primary Standard	Washington State Standard	PSCAA Regional Standard
CARBON MONOXIDE (CO)			
One-Hour Average (not to be exceeded more than once per year)	35 ppm	35 ppm	35 ppm
Eight-Hour Average (not to be exceeded more than once per year)	9 ppm	9 ppm	9 ppm
PM_{10}			
Annual Arithmetic Mean	50 µg/m^3	50 µg/m^3	50 µg/m^3
24-Hour Average Concentration (not to be exceeded more than once per year)	150 µg/m^3	150 µg/m^3	150 µg/m^3
$PM_{2.5}$			
Annual Arithmetic Mean	15 µg/m^3	NS	NS
24-Hour Average Concentration (not to be exceeded more than once per year)	65 µg/m^3	NS	NS
TOTAL SUSPENDED PARTICULATES (TSP)			
Annual Arithmetic Mean	NS	60 µg/m^3	60 µg/m^3
24-Hour Average Concentration (not to be exceeded more than once per year)	NS	150 µg/m^3	150 µg/m^3
OZONE			
One-Hour Average (not to be exceeded more than once per year)	0.12 ppm	0.12 ppm	0.12 ppm
Eight-Hour Average (not to be exceeded more than once per year)	0.08 ppm	NS	NS

Notes: ppm = parts per million
µg/m^3 = micrograms per cubic meter
NS = No Standard
Sources: 40 CFR Part 50 (1997)
WAC chapters. 173-470, 173-474, 173-175 (1987)

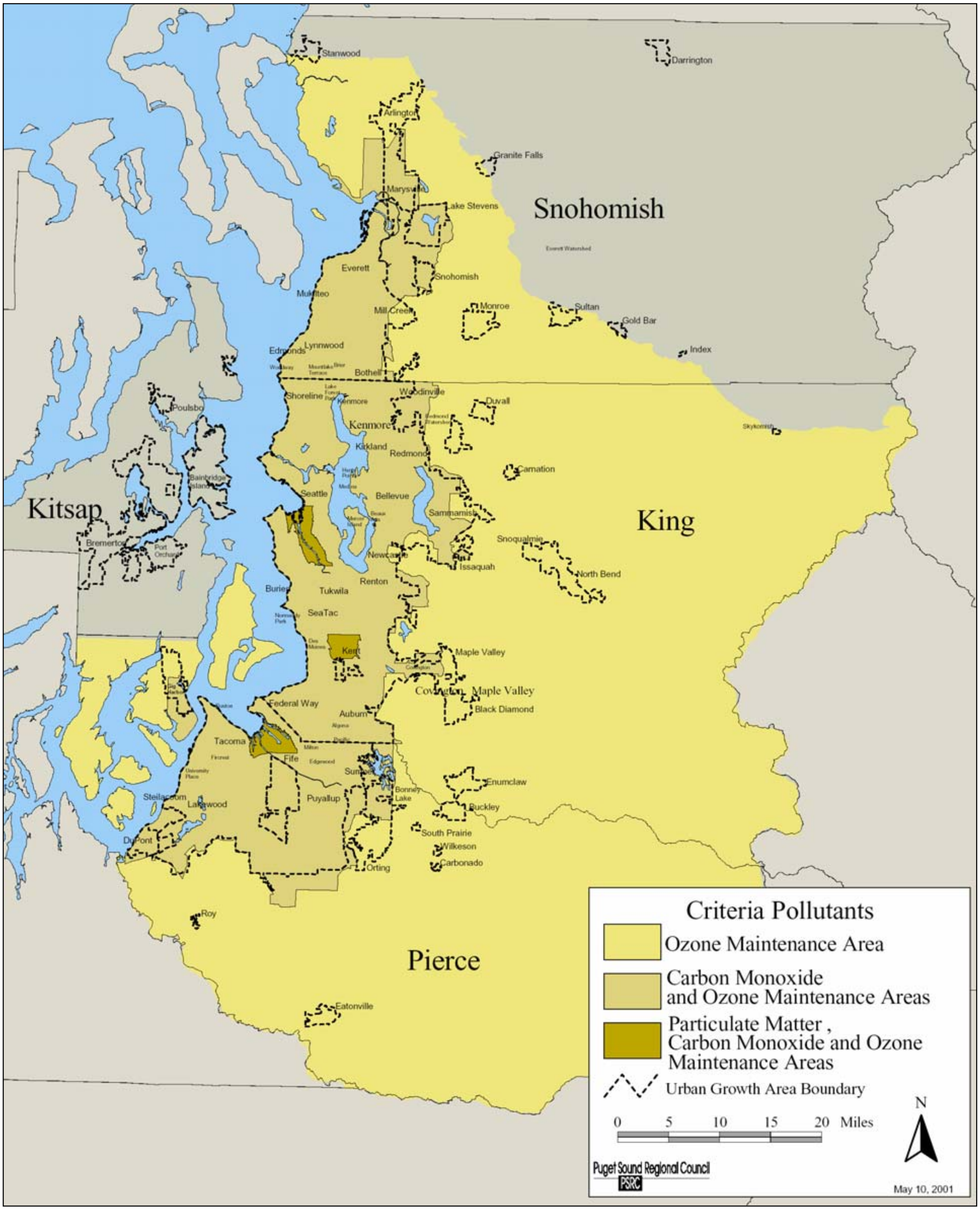


Figure 2-1: Puget Sound Region Maintenance Areas

2.1.1 Climate

Weather directly influences air quality. Important meteorological factors include wind speed and direction, atmospheric stability, temperature, sunlight intensity, and mixing depth. Temperature inversions, which are associated with higher air pollution concentrations, occur when warmer air overlies cooler air. During temperature inversions in late fall and winter, particulates and CO from wood stoves and vehicle sources can be trapped close to the ground, which can lead to violations of the NAAQS. In the greater Puget Sound area, the highest ozone concentrations occur from mid-May until mid-September, when urban emissions are trapped by temperature inversions and followed by intense sunlight and high temperatures.

2.1.2 Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, poisonous gas that reduces the blood's oxygen-carrying capability by bonding with hemoglobin and forming carboxyhemoglobin, which prevents oxygenation of the blood. Exposure to CO concentrations of 80 ppm over eight hours results in a carboxyhemoglobin level of approximately 15 percent (Erlich, 1977). Acute health effects such as headaches, slowed reflexes, weakened judgment, and impaired perception begins at about 3 percent carboxyhemoglobin (carbon monoxide bonding with 3 percent of the hemoglobin). Chronic effects include aggravation of pre-existing cardiovascular disease and increased heart disease risk in healthy individuals. At carboxyhemoglobin levels of approximately 30 percent, individuals become nauseous and collapse, and at very high levels (above 50 percent carboxyhemoglobin) individuals are in danger of losing their lives.

The major source of CO is vehicular traffic, industry, wood stoves, and slash burns. In urban areas, motor vehicles are often the source of over 90 percent of the CO emissions that cause ambient levels to exceed the NAAQS (EPA, 1992).

Areas of high CO concentrations are usually localized. They occur near congested roadways and intersections in fall and winter and are associated with light winds, cool temperatures, and stable atmospheric conditions. These localized areas of elevated CO levels are referred to as *hot spots*. Decreased CO concentrations in most areas have resulted from stringent federal emission standards for new vehicles and the gradual replacement of older, more polluting vehicles. CO levels have declined in urban areas, but are leveling off in areas experiencing rapid growth in traffic volumes, including the greater Puget Sound region.

2.1.3 Particulate Matter

Particulate matter includes small particles of dust, soot, and organic matter suspended in the atmosphere. Particulates less than 100 micrometers in diameter are measured as Total Suspended Particulates (TSP). Particles less than 10 micrometers in size are measured as PM_{10}, a component of TSP. Particles less than 2.5 micrometers in size are measured as $PM_{2.5}$, a component of PM_{10} and TSP. The smaller $PM_{2.5}$ and PM_{10} particles can be inhaled deeply into the lungs. This can potentially lead to respiratory diseases and cancer, because particulate matter may carry absorbed toxic substances and the particle itself may be inherently toxic.

Particulate matter can affect visibility, plant growth, and building materials. Sources of particulates include motor vehicles, industrial boilers, wood stoves, open burning, and dust from roads, quarries, and construction activities. Most vehicular emissions are in the $PM_{2.5}$-size range, and road and construction dust is often in the larger PM_{10} range. Most fine-particulate vehicle emissions result from diesel vehicles, which release fine particulates both directly (mostly as carbon compounds) and indirectly in the form of sulfur dioxide (SO_2), a gas that reacts in the atmosphere to form sulfate particulates. High $PM_{2.5}$ and PM_{10} concentrations occur in fall and winter during periods of air stagnation and high use of wood for heat.

Particulates emitted from diesel vehicles pose specific health risks compared to other types of particulate matter. The EPA's Clean Air Scientific Advisory Committee is currently reviewing recent health assessment data on diesel emissions, but the data is not yet available for citation. Previous EPA research (EPA, 1993) found that components of diesel particulates (primarily high-molecular-weight organic compounds) have several negative health effects, including carcinogenesis, accumulation of particles in the lungs, tissue inflammation, respiratory irritation, and other related effects. Health effects associated with diesel particulates was one of the major contributing factors to establishing the new $PM_{2.5}$ standard.

2.1.4 Ozone

Ozone is a highly toxic form of oxygen and a major component of the complex chemical mixture that forms photochemical smog. Ozone is not produced directly, but is formed by a reaction between sunlight, nitrogen oxides (NO_x), and hydrocarbons (HC). Ozone is primarily a product of regional vehicular traffic, point-source, and fugitive emissions of the ozone precursors. Tropospheric (ground-level) ozone, which results from ground-level precursor emissions, is a health-risk. Stratospheric (upper-atmosphere) ozone, which is produced through a different set of chemical reactions that only require oxygen and intense sunlight, protects people from harmful solar radiation. In the remainder of this report, the term ozone refers to tropospheric ozone.

Ozone irritates the eyes and respiratory tract and increases the risk of respiratory and heart diseases. Ozone reduces the lung function of healthy people during exercise, can cause breathing difficulty in susceptible populations, such as asthmatics and the elderly, and damages crops, trees, paint, fabric, and synthetic rubber products. The severity of health effects is both dose and exposure-duration related (National Research Council, 1992). As with $PM_{2.5}$, the EPA has adopted a new eight-hour ozone standard (Table 2-1), but the old one-hour standard is still applicable for current nonconformity and maintenance areas. Regional ozone planning efforts by PSCAA consider both standards.

In the Puget Sound area, the highest ozone concentrations occur from mid-May until mid-September, when urban emissions are trapped by temperature inversions followed by intense sunlight and high temperatures. Maximum ozone levels generally occur between noon and early evening at locations several miles downwind from sources, after NO_x and HC have had time to mix and react under sunlight. Light, northeasterly winds arising during these conditions result in high ozone concentrations near the Cascade foothills, to the south and southeast of major cities.

Chapter 3 Project Description

The City of Seattle, in cooperation with the U.S Department of Transportation Federal Transit Administration (FTA), proposes to construct a new streetcar line to serve the downtown, Denny Triangle and South Lake Union areas of Seattle. This line would provide local transit service, connect to the regional transit system, accommodate economic development, and contribute to neighborhood vitality. The project elements and construction are discussed in detail in the *South Lake Union Streetcar Project Description Memo* (Parsons Brinckerhoff, March 2005).

The proposed South Lake Union Streetcar would begin in the vicinity of the intersection of Westlake Avenue and Olive Way/5th Avenue in downtown Seattle (see Figure 3-1). It would extend north through the Denny Triangle and South Lake Union neighborhoods and terminate in the vicinity of Fairview Avenue N. and Ward Street near the Fred Hutchinson Cancer Research Center. The line would connect these neighborhoods and destinations with the regional transit hub at Westlake Center, which will be a major connection point for light rail, buses and monorail. The length of the proposed streetcar line is approximately 1.3 miles in each direction (2.6 track miles total) and the tracks and stops would be constructed entirely within existing right-of-way.

The streetcar would share the street with automobile traffic. Initially, the streetcar is expected to operate for 15 hours per day (roughly 6 AM to 9 PM), with fifteen minutes between cars. Ultimately, the system is expected to operate for 18 hours per day (roughly 5 AM to 11 PM), with ten minutes between cars.

As shown in Figure 3-1, streetcar stops would typically be side-platform corner-curb bulbs located within the parking lane at the far side of an intersection. Two stops would be center platform configurations: one within Fairview Avenue N. at the Fred Hutchinson campus and one in the railbank north of Valley Street adjacent to South Lake Union Park.

Bi-directional, low-floor, single-car, articulated streetcars are proposed. They are typically 66 feet long, 11.5 feet high, and 8 feet wide and run on standard gauge tracks. The streetcar would be powered by an overhead electrical system similar to those used by streetcars in cities such as Tacoma, Washington and Portland, Oregon.

A maintenance facility at the southwest corner of Fairview Avenue N. and Valley Street is also planned as part of this project. The maintenance facility building would be approximately 100 x 70 feet. Two additional yard storage tracks would also be provided. Daily vehicle maintenance and inspections and minor repairs would be completed at the facility.

In the typical construction method for the streetcar track system, the top 12 to 18 inches of pavement would be removed and replaced with rail-embedded reinforced concrete slabs within a trench approximately eight feet wide. This project would also involve upgrading the stormwater detention system in several locations.

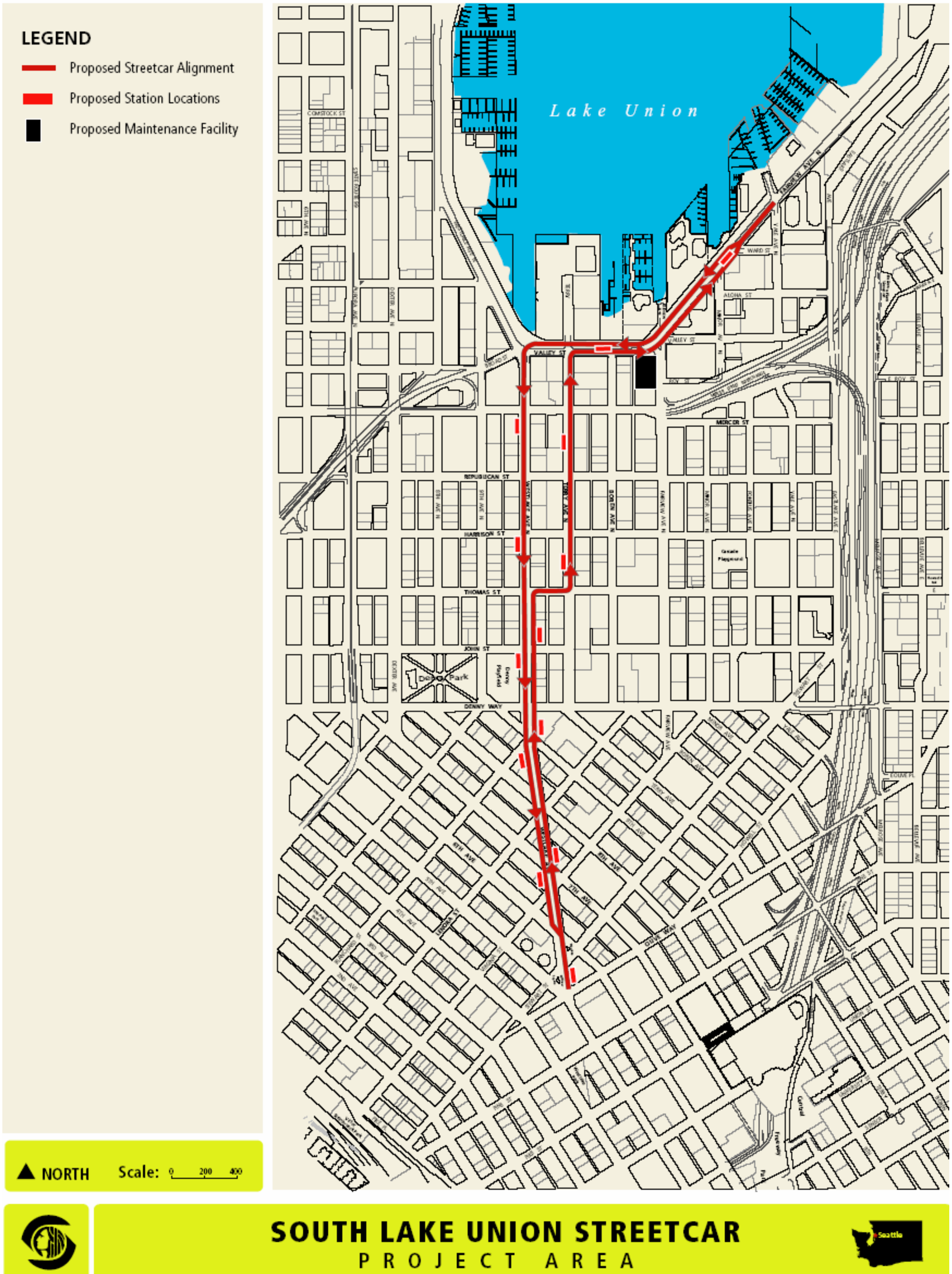


Figure 3-1: Project Area

Chapter 4 Methodology

For the South Lake Union Streetcar project and most other roadway air quality studies, predictions of existing and future localized air pollution concentrations in the project vicinity are made for CO only. Most other pollutants must be monitored and dealt with regionally. This is done for three reasons:

- Total CO emissions are greater than the emissions of all other pollutants from automobiles combined (MOBILE 6.2 results). See Section 4.1 for a description of the MOBILE 6.2 model.
- Motor vehicles are the greatest source of CO emissions, accounting for more than 90 percent of total CO emissions in urban areas. Therefore, it is generally not necessary to account for other, often unquantified, sources of CO near the project area (U.S. EPA, 1993).
- CO emissions from motor vehicles may be high enough to affect individuals in the immediate area, while most other pollutants are not (Erlich, 1977).

Figure 4-1 shows the intersections modeled for CO levels. These intersections include the three highest volumes and the three highest delays intersections directly affected by the South Lake Union Streetcar Project. Average carbon monoxide (CO) peak-hour concentrations (in parts per million: ppm) were estimated for the following intersections for existing conditions (2002), year of opening (2007), and the project design year (2030):

- Valley Street and Westlake Avenue
- Mercer Street and Westlake Avenue
- Mercer Street and Terry Avenue
- Harrison Street and Westlake Avenue
- Denny Way and Westlake Avenue

CO concentrations with and without the streetcar were estimated using the PM peak-hour traffic volumes presented in the *Draft Technical Report South Lake Union Streetcar Project – Transportation* (Parsons Brinckerhoff Quade & Douglas, Inc., 2005) using MOBILE 6.2 emission factors and CAL3QHC software.

4.1 MOBILE 6.2 Model

MOBILE 6.2 is an updated version of the Mobile Source Emission Factor Model computer program, which the EPA developed to calculate emission factors from highway motor vehicles in the units of grams of pollutant per mile traveled. Because MOBILE 6.2 accounts for gradual replacement of older vehicles with newer, less-polluting vehicles, the predicted emission rates for future years are lower than current emission rates.

Air quality pollutant emission factors for analysis of existing conditions (2002), opening year (2007), and design year (2030), with and without the streetcar, were provided by the Puget Sound Regional Council (PSRC).

LEGEND
Proposed Streetcar Alignment
Proposed Station Locations
Proposed Maintenance Facility
CO Modeled Intersection
NORTH
Scale: 0 200 400
Lake Union
FAIRVIEW AVE N
MERCER ST
REPUBLICAN ST
HARRISON ST
THOMAS ST
JOHN ST
DENNY WAY
Denny Park
BOREN AVE N
6TH AVE
7TH AVE
8TH AVE
OLIVE WAY

4.2 CAL3QHC Model

CAL3QHC Version 2 is a line-source dispersion model that predicts pollutant concentrations near roadways. CAL3QHC input variables include MOBILE 6.2 free-flow and calculated idle emission factors, roadway geometries, traffic volumes, site characteristics, background pollutant concentrations, signal timing, and meteorological conditions. CAL3QHC predicts inert pollutant concentrations in ppm averaged over a one-hour period near roadways. CAL3QHC was used to predict CO concentrations at affected project area intersections (Appendix A).

CAL3QHC predicts peak one-hour pollutant concentrations based on stable meteorology and peak-hour traffic flow. This study assumed a wind speed of 3 feet per second and evaluated wind directions in 10-degree increments to select the worst-case wind angle. Background CO concentrations were assumed to be 3 ppm averaged over one hour, to represent Puget Sound conditions (WDOE, 1995). An atmospheric stability class of D (urban land use) was modeled according to EPA Guidance (EPA, 1992). These conditions do not usually persist for an eight-hour period, so the worst-case eight-hour CO concentrations are lower than the maximum one-hour concentrations. The eight-hour average CO concentration is calculated by multiplying the maximum one-hour concentration by a persistence factor, which accounts for the time variance in traffic and meteorological conditions. The EPA recommends a persistence factor of 0.7 for this area (EPA, 1992), and the background eight-hour CO concentrations were assumed to be 2.1 ppm.

Free-flow traffic was modeled at the posted speed limit. Traffic volumes were obtained from the *Draft Technical Report South Lake Union Streetcar Project – Transportation* (Parsons Brinckerhoff Quade & Douglas, Inc., 2005). Traffic operations data, including turn movements, signal times, and saturation flow rates were taken from the Synchro runs completed as part of the traffic study for the streetcar project.

Specific locations where CO concentrations are predicted are known as *receptors*. Receptors are modeled in locations where maximum concentrations would likely occur because of traffic congestion, and where the general public would have access (EPA, 1992). For this analysis, receptors were located in areas accessible to the general public at mid-distance from the edge of the travel lane and 6 feet off the ground. At each intersection, individual receptors were modeled from the corners and at 75-foot intervals, at a distance of 10 feet from the intersection. Only the highest concentration of CO at each intersection was reported for each modeled scenario.

Typical link and receptor geometry is illustrated in Figure 4-2. Unsignalized operations were approximated by modeling stopped traffic using a short-duration signal cycle. Unstopped traffic was modeled as free-flowing.

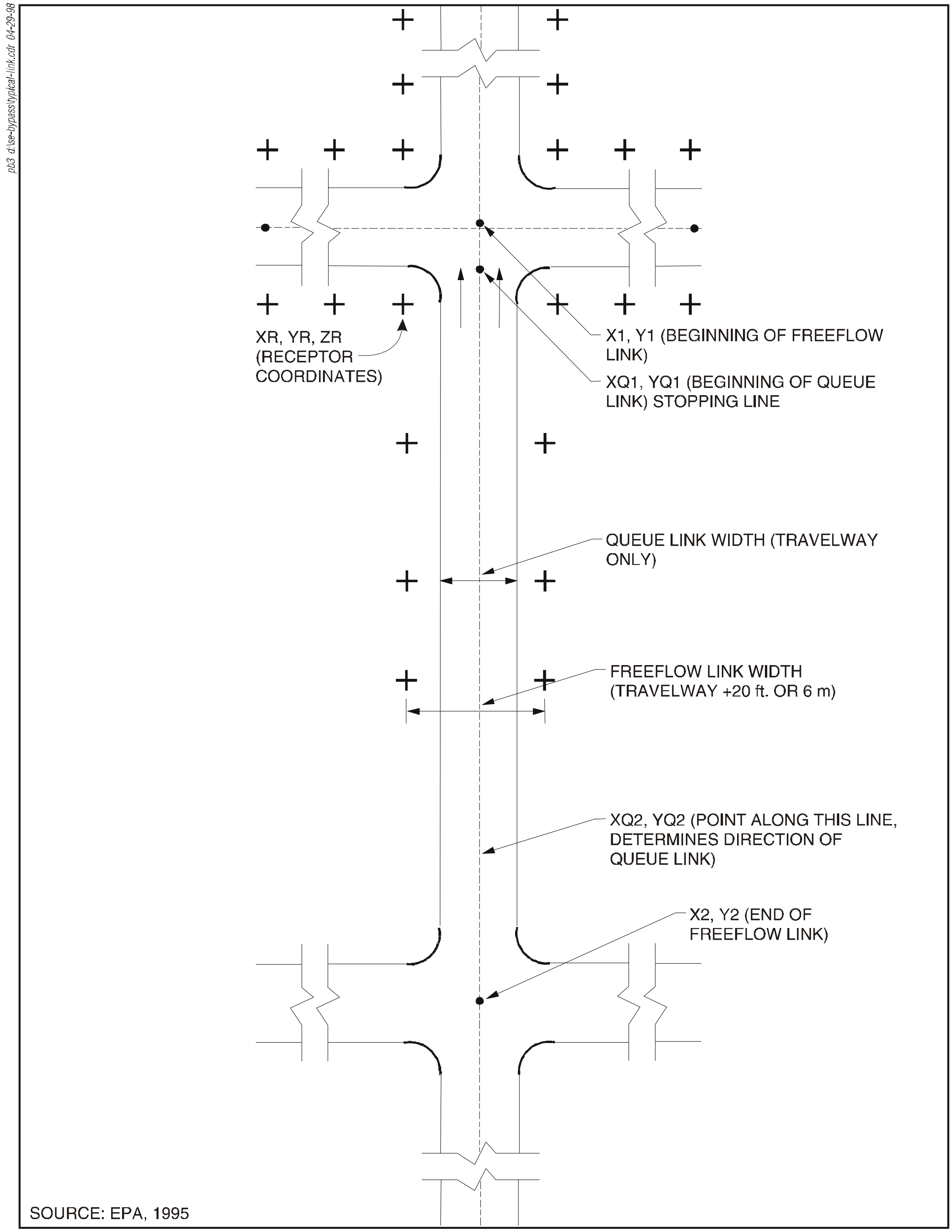


Figure 4-2: Typical Link and Receptor Geometry

Chapter 5 Affected Environment

This chapter describes the project area, emission trends and localized carbon monoxide (CO) concentrations.

5.1 Description of Project Area

Land uses adjacent to the proposed streetcar project area include residential, commercial and industrial. The terrain is relatively flat.

5.2 Emission Trends

Fuel combustion by motor vehicles and other sources releases carbon dioxide (CO_2), which is a "greenhouse gas" that traps heat within the earth's atmosphere. CO_2 is not directly harmful to human health and is not a criteria pollutant. Considerable progress has been made in the U.S. and in the Puget Sound region to reduce criteria air pollutant emissions from motor vehicles and improve air quality since the 1970s, even as vehicle travel has increased rapidly.

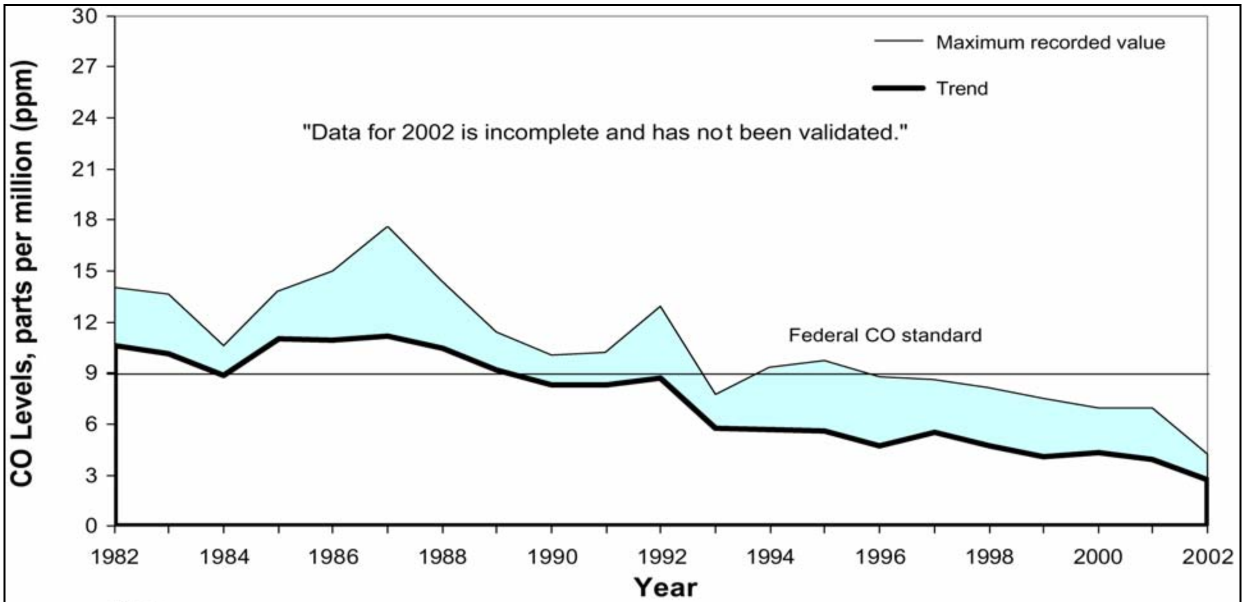
Nationally, emissions of criteria pollutants decreased 25 percent between 1970 and 2001. In general, the air is noticeably cleaner than in 1970, and all criteria pollutant emissions from motor vehicles are less than they were in 1970 despite the fact that vehicle miles of travel have more than doubled. Still, challenges remain. Based on monitored data, approximately 46 million people in the U.S. reside in counties that did not meet the air quality standard for at least one National Ambient Air Quality Standards (NAAQS) pollutant in 1996 (EPA 1996 and EPA 2002).

5.2.1 National Air Pollution Trends

Nationwide, air pollutant emissions from motor vehicles have dropped considerably since 1970. Volatile Organic Compound emissions (also referred to as hydrocarbon (HC) emissions) are down 38 percent, oxides of nitrogen (NO_x) emissions have increased 15 percent, emissions from particulate matter less than 10 micrometers in size (PM_{10}) are down 76 percent, and carbon monoxide (CO) emissions are down 19 percent. These reductions have occurred along with increasing population, economic growth, and vehicle travel (EPA, 2002).

5.2.2 Regional Air Pollution Trends

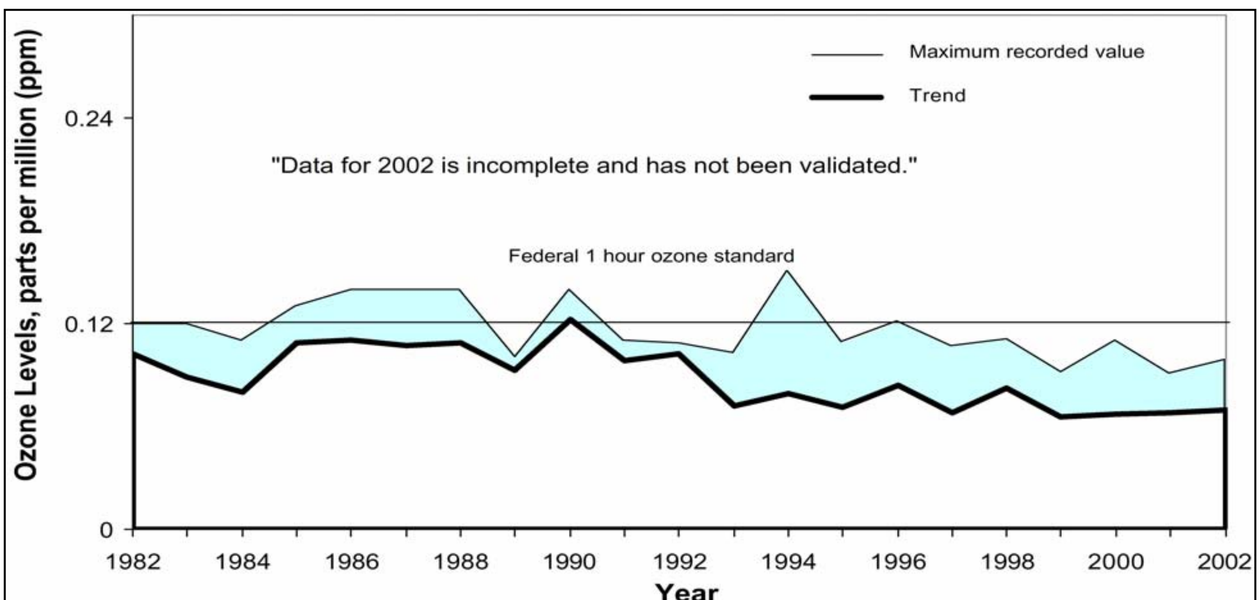
Regional air pollutant trends have generally followed national patterns over the last 20 years. Carbon monoxide (CO) is the criteria pollutant most closely tied to transportation, and over 90 percent of the CO emissions in the Puget Sound region come from transportation sources. Regionally, the maximum measured CO concentrations have decreased over the past 20 years (Figure 5-1). Other transportation pollutants have followed similar but less pronounced trends (Figure 5-2).



Note:
The trend line represents the average of the carbon monoxide values that fall within the upper one percent of the observations.

Source:
2000-2003 Air Quality Trends Report (Washington Department of Ecology, 2003)

Figure 5-1: Puget Sound CO Trends



Note:
The trend line represents the average of the ozone values that fall within the upper one percent of the observations.

Source:
2000-2003 Air Quality Trends Report (Washington Department of Ecology, 2003)

Figure 5-2: Puget Sound Ozone Trends

5.3 Localized Carbon Monoxide Concentrations

CO concentrations were modeled at the following intersections:

- Valley Street and Westlake Avenue
- Mercer Street and Westlake Avenue
- Mercer Street and Terry Avenue
- Harrison Street and Westlake Avenue
- Denny Way and Westlake Avenue

The predicted worst-case CO concentrations for existing conditions (2002) would not exceed the one-hour average or the eight-hour average National Ambient Air Quality Standards (NAAQS) for CO at any location (Table 6-1). Predicted maximum one-hour CO concentrations from vehicle emissions ranged between 9.9 ppm and 12.1 ppm. This is below the one-hour average NAAQS of 35 ppm for CO. Predicted maximum eight-hour CO concentrations from vehicle emissions ranged between 6.9 ppm and 8.5 ppm. This is below the eight-hour average NAAQS of 9 ppm for CO.

Chapter 6 Environmental Consequences

6.1 Operation

The maximum estimated one-hour CO concentrations from vehicle emissions with the streetcar would range between 5.7 and 10.8 ppm in 2007 and between 4.3 and 7.5 ppm in 2030 (see Table 6-1). The maximum estimated eight-hour CO concentrations would range from 4.0 and 7.6 ppm in 2007 and between 3.0 and 5.3 ppm in 2030 (see Table 6-2). No exceedance of the NAAQS for CO is predicted with the streetcar.

Table 6-1: Maximum One-Hour Average CO Concentrations

Intersection	2002 Existing Conditions	2007 Without Streetcar	2007 With Streetcar	2030 Without Streetcar	2030 With Streetcar
Valley Street and Westlake Avenue	12.1	9.7	9.8	4.9	5.2
Mercer Street and Westlake Avenue	11.3	10.8	10.8	7.5	7.5
Mercer Street and Terry Avenue	N/A	8.6	8.6	5.8	5.9
Harrison Street and Westlake Avenue	6.8	5.7	5.7	4.3	4.3
Denny Way and Westlake Avenue	9.9	7.3	7.3	5.5	5.5

N/A – This intersection is not signalized.
Concentration values are in parts per million (ppm).
The one-hour NAAQS for CO is 35 ppm.

Table 6-2: Maximum Eight-Hour Average CO Concentrations

Intersection	2002 Existing Conditions	2007 Without Streetcar	2007 With Streetcar	2030 Without Streetcar	2030 With Streetcar
Valley Street and Westlake Avenue	8.5	6.8	6.9	3.4	3.6
Mercer Street and Westlake Avenue	7.9	7.6	7.6	5.3	5.3
Mercer Street and Terry Avenue	N/A	6.0	6.0	4.1	4.1
Harrison Street and Westlake Avenue	4.8	4.0	4.0	3.0	3.0
Denny Way and Westlake Avenue	6.9	5.1	5.1	3.9	3.9

N/A – This intersection is not signalized.
Concentration values are in parts per million (ppm).
The eight-hour NAAQS for CO is 9 ppm.

The modeled intersections include all areas affected by the project that are accessible to the general public and where elevated CO concentrations will be likely to occur. With the streetcar, reductions in CO emissions experienced by removing single-occupancy vehicles from surface streets are offset by the increased time other cars spend idling at red lights waiting for the streetcar to pass. CO levels are the same for all intersections with and without the streetcar, except for at the Valley Street and Westlake Avenue where CO levels increase very slightly, by 0.1 ppm. Because the project would not cause or contribute to any violation of the NAAQS for CO, it would not cause any adverse localized CO impacts.

6.2 Construction

During the construction of the street car, air pollutant emissions would occur. Fugitive emissions from particulate matter less than 10 micrometers in size (PM_{10}) would be associated with demolition, ground excavation, and cut-and-fill operations.

PM_{10} emissions would vary from day to day, depending on the level of activity, specific operations, and weather conditions. PM_{10} emissions would depend on soil moisture, silt content of soil, wind speed, and the amount and type of operating equipment. Larger dust particles would settle near the source, and fine particles would be dispersed over greater distances from the construction site.

The quantity of particulate emissions would be proportional to the area of the construction operations and the level of activity. Based on field measurements of suspended dust emissions from construction projects, an approximate emission factor for construction operations would be 1.2 tons per acre of construction per month of activity (U.S. EPA, 1999). Emissions would be reduced if less site area was disturbed or mitigation was performed.

Several residences are within 200 feet of the construction area for the proposed streetcar route. At that distance, fugitive PM_{10} emissions from construction activities would be noticeable, if uncontrolled. Mud and particulates from trucks would also be noticeable if construction trucks would be routed through residential neighborhoods. Construction would require mitigation measures to comply with the Puget Sound Clean Air Agency (PSCAA) regulations that require dust control during construction and prevent the deposition of mud on paved streets (PSCAA Regulation 1, Article 9). Measures to reduce the deposition of mud and emissions of particulates are identified in the *Mitigation* section of this report.

In addition to particulate emissions, heavy trucks and construction equipment powered by gasoline and diesel engines would generate small particulates, CO, and NO_x in exhaust emissions. If construction traffic and lane closures were to increase congestion and reduce the speed of other vehicles in the area, emissions from traffic would increase temporarily while those vehicles are delayed. These emissions would be temporary and limited to the immediate area surrounding the construction site.

Some construction phases (particularly during paving operations using asphalt) would result in short-term odors. These odors might be detectable to some people near the project site, and would be diluted as distance from the site increases. There would be no burning of slash.

6.3 Conformity Determination

The South Lake Union Streetcar Project area lies within ozone and CO maintenance areas and must comply with the project-level conformity criteria of the EPA Conformity Rule and with WAC Chapter 173-420. Regionally significant projects in non-attainment and maintenance areas must be included in a conforming Metropolitan Transportation Plan (MTP) and Transportation Improvement Plan (TIP) by the regional Metropolitan Planning Organization (MPO). The South Lake Union Streetcar Project is included in the latest version of the Puget Sound Regional Council (PSRC) MTP and TIP as number SEA-130. As stated in 40 Code of Federal Regulation (CFR) Part 93, the following criteria must be met when determining project conformity. A brief summary of the project's conformity to the State Implementation Plan (SIP) is discussed with each criterion (criteria are indicated by italics and a reference to where they are required in the CFR).

- *The conformity determination must be based on the latest planning assumptions (40CFR Part 93.110).* The project is included in the latest version of the PSRC's MTP and TIP as Project SEA-130. The plans rely on the most current planning assumptions approved by the PSRC.
- *The conformity determination must be based on the latest emission estimation model available (40CFR Part 93.111).* Emissions to determine conformity to the MTP and TIP were calculated using MOBILE 6.2, the emission model used to model conformity of the current Puget Sound Air Quality Maintenance Plans.
- *The project must come from a conforming transportation plan and program (40CFR Part 93.114).* The South Lake Union Streetcar Project is included in the latest version of the PSRC's MTP and TIP as Project SEA-130. The MTP and TIP conform to the current Puget Sound Air Quality Maintenance Plans.
- *There must be a current conforming plan and a current conforming TIP at the time of project approval (40CFR Part 93.115).* There is a current conforming MTP and TIP.
- *The FHWA project must not cause or contribute to any new localized CO or violation in CO and PM_{10} nonattainment or maintenance areas (40CFR Part 93.116).* The project is located in a CO maintenance area. As shown in Table 6-1 and Table 6-2, no CO violations would occur in the project area in 2007 or 2030. The project area is in conformity for PM_{10}.
- *The FHWA project must comply with PM_{10} control measures in the applicable implementation plan (40CFR Part 93.117).* The proposed project area is in conformity for PM_{10}, so no implementation plan is required.

Conformity Finding: The project meets the criteria of 40 CFR Part 93 and WAC 173-420 for projects from a conforming plan and TIP. The project also meets all of the hot-spot criteria of 40 CFR Part 93 and WAC 173-420-065, and the conformity criteria of the EPA Conformity Rule, 40 CFR Part 93 and WAC 173-420. The project also conforms to the SIP.

Chapter 7 Mitigation

7.1 Operation

Because no exceedances of National Ambient Air Quality Standards (NAAQS) are predicted, no design or operational changes would be required.

7.2 Construction

All structures to be demolished would be evaluated for asbestos containing materials. If asbestos is found, the contractor will follow EPA and Puget Sound Clean Air Agency (PSCAA) regulations for removal and disposal.

Particulate emissions (in the form of fugitive dust during construction activities) are regulated by the PSCAA. The operator of a source of fugitive dust must take reasonable precautions to prevent fugitive dust from becoming airborne and maintain and operate the source to minimize emissions. Construction impacts from the streetcar project would be reduced by requiring contractors to meet City of Seattle Standard Specification 1-07.5(3), which requires contractors to meet the requirements of the PSCAA. Possible mitigation measures that would be used to control PM10, deposition of particulate matter, and emissions of CO and NOx during construction include:

- Covering stockpiles and spraying exposed soil with water or other dust palliatives to reduce emissions of PM_{10} and deposition of particulate matter.
- Covering all trucks transporting materials, wetting materials in trucks, or providing adequate freeboard (space from the top of the material to the top of the truck) to reduce PM_{10} and deposition of particulates during transportation.
- Sweeping to remove particulate matter deposited on paved, public roads to reduce mud on area roadways.
- Routing and scheduling construction trucks to reduce delays to traffic during peak travel times, to reduce secondary air quality impacts caused by a reduction in traffic speeds while waiting for construction trucks.
- Placing quarry spall aprons where trucks enter public roads to reduce mud track-out.
- Requiring appropriate emission-control devices on all construction equipment powered by gasoline or diesel fuel, to reduce CO and NOx emissions in vehicular exhaust.

Chapter 8 Secondary/Cumulative Impacts

Secondary and cumulative impacts and benefits may occur in the proposed streetcar project area. Generally, secondary impacts and benefits result from a proposed project action, but take place later in time than the initial action. Cumulative impacts and benefits result from the combined effects of several proposed or considered project actions that may take place in the project area before, during, or after the project timeframe.

8.1 Secondary Impacts and Benefits

The air quality analysis described in this report was performed using projected traffic volumes for the future years, including the effects of other planned transportation improvements. Therefore, the air quality analysis includes the project's secondary effects and other traffic growth that would be associated with the project.

8.2 Cumulative Impacts and Benefits

The air quality analysis described in this report was performed using projected traffic volumes that incorporate anticipated traffic generation from planned development in the project vicinity. Therefore, the air quality analysis includes the cumulative affects of the project and other traffic growth that would be associated with the project.

Chapter 9 References

Associated General Contractors of Washington. *Guide to Handling Fugitive Dust from Construction Projects*. Seattle, WA, 1997.

Code of Federal Regulations. *40 CFR Part 93: Determining Conformity of Federal Actions to State or Federal Implementation Plans*. Washington, D.C., 1997.

Puget Sound Regional Council. *Guidebook for Conformity and Air Quality Analysis Assistance for Nonattainment Areas.* Seattle, Washington, 1995.

Puget Sound Regional Council. *Destination 2030 Metropolitan Transportation Plan for the Central Puget Sound Region*. Seattle, Washington, May 2001.

U.S. Environmental Protection Agency. *Guideline for Modeling Carbon Monoxide from Roadway Intersections*. Report Number EPA-454/R-92-005. Research Triangle Park, North Carolina, November 1992.

U.S. Environmental Protection Agency. *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections*. Report Number EPA-454/R-92-006. Research Triangle Park, North Carolina, September 1995.

Washington Administrative Code. *Chapter 173-420. Conformity of Transportation Activities to Air Quality Implementation Plans*. Olympia, Washington, 1996.

Washington State Department of Ecology. *Mobile 6 Input Files for the Puget Sound Region*. Olympia, Washington, 2003.

Washington State Department of Ecology. *Guidebook for Conformity and Air Quality Analysis Assistance for Nonattainment Areas*. Olympia, Washington, 1995.

Washington State Department of Ecology, *1999 Air Quality Trends*. Olympia, Washington, 2000.

Washington State Department of Transportation, *Environmental Procedures Manual*. Olympia, Washington, 2001.

Appendix A Air Quality Modeling Data Files

Appendix A is supplied as a separate document